

What is claimed is:

1. A method of manufacturing a semiconductor device,  
comprising;

depositing an Al-Cu interconnection layer with a nitrogen  
5 concentration in an atmosphere in a sputtering deposition chamber  
made to be higher than 12ppm but lower than 1000ppm.

2. The method of manufacturing a semiconductor device  
according to claim 1, wherein the nitrogen concentration in the  
atmosphere in the sputtering deposition chamber is controlled by  
10 introducing nitrogen-containing argon gas into the deposition  
chamber.

3. The method of manufacturing a semiconductor device  
according to claim 2, wherein in the case that the nitrogen  
concentration is made to be less than 200ppm, the nitrogen  
15 concentration is controlled by introducing into the deposition  
chamber argon gas to which has been added 0.1% of nitrogen as a  
partial pressure proportion.

4. The method of manufacturing a semiconductor device  
according to claim 2, wherein in the case that the nitrogen  
20 concentration is made to be at least 200ppm, the nitrogen  
concentration is controlled by introducing into the deposition  
chamber argon gas to which has been added 0.5% of nitrogen as a  
partial pressure proportion.

5. The method of manufacturing a semiconductor device  
25 according to claim 1, wherein the nitrogen concentration in the  
atmosphere in the sputtering deposition chamber is controlled by

regulating a flow rate of argon gas and a flow rate of nitrogen-added argon gas.

6. The method of manufacturing a semiconductor device according to claim 5, wherein the nitrogen concentration in the atmosphere in the sputtering deposition chamber is controlled by making a flow rate of heated argon gas be 15sccm, making the flow rate of the argon gas be at least 50sccm but less than 66sccm, and making the flow rate of the nitrogen-added argon gas be more than 0sccm but not more than 12.7sccm.

7. A method of manufacturing a semiconductor device, comprising:

forming a substrate insulating film on a semiconductor substrate;

forming a barrier layer on the substrate insulating film;

forming an Al-Cu interconnection layer on the barrier layer by sputtering under a condition that a nitrogen concentration in an atmosphere in a sputtering deposition chamber is higher than 12ppm but lower than 1000ppm; and

forming an anti-reflective film on the Al-Cu interconnection layer.

8. The method of manufacturing a semiconductor device according to claim 7, wherein the step of forming the barrier layer is a step of forming a first titanium film, a titanium nitride film, and a second titanium film on top of one another in this order.

9. The method of manufacturing a semiconductor device according to claim 8, wherein the forming the anti-reflective film

is a forming a titanium nitride film.

10. The method of manufacturing a semiconductor device according to claim 7, wherein the nitrogen concentration in the atmosphere in the sputtering deposition chamber is controlled by  
5 introducing nitrogen-containing argon gas into the deposition chamber.

11. The method of manufacturing a semiconductor device according to claim 10, wherein in the case that the nitrogen concentration is made to be less than 200ppm, the nitrogen  
10 concentration is controlled by introducing into the deposition chamber argon gas to which has been added 0.1% of nitrogen as a partial pressure proportion.

12. The method of manufacturing a semiconductor device according to claim 10, wherein in the case that the nitrogen  
15 concentration is made to be at least 200ppm, the nitrogen concentration is controlled by introducing into the deposition chamber argon gas to which has been added 0.5% of nitrogen as a partial pressure proportion.

13. The method of manufacturing a semiconductor device  
20 according to claim 10, wherein the nitrogen concentration in the atmosphere in the sputtering deposition chamber is controlled by regulating a flow rate of argon gas and a flow rate of nitrogen-added argon gas.

14. The method of manufacturing a semiconductor device  
25 according to claim 10, wherein the nitrogen concentration in the atmosphere in the sputtering deposition chamber is controlled by

making a flow rate of heated argon gas be 15sccm, making a flow rate of argon gas be at least 50sccm but less than 66sccm, and making a flow rate of nitrogen-added argon gas be more than 0sccm but not more than 12.7sccm.

5           15.    A method of manufacturing a semiconductor device, comprising:

          forming a substrate insulating film on a semiconductor substrate;

          forming, on the substrate insulating film, a barrier layer  
10   in which are formed on top of one another a plurality of films including at least a Ti film and at least a TiN film, wherein an uppermost film out of the plurality of films is a TiN film that is formed by carrying out sputtering under a condition that an atmosphere in a sputtering deposition chamber contains nitrogen;  
15   and

          forming, on the barrier layer, an Al-Cu interconnection layer by sputtering under a condition that the atmosphere in the sputtering deposition chamber substantially does not contain nitrogen, while discharging nitrogen into the atmosphere in the sputtering  
20   deposition chamber from the TiN film that is the uppermost layer of the barrier layer by regulating a deposition temperature.

          16.    The method of manufacturing a semiconductor device according to claim 15, wherein when forming the Al-Cu interconnection layer by the sputtering, the deposition temperature  
25   is made to be a temperature in a range of 200 to 400°C.